PROCEEDINGS

of

ENTOMOLOGICAL SOCIETY *of* BRITISH COLUMBIA

Volume 49 **Issued June 15th, 1953**

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A DECADE OF PEST CONTROL IN BRITISH COLUMBIA ORCHARDS[1]

J. MARSHALL[2]
Fruit Insect Laboratory, Summerland, British Columbia

The last ten years have brought more significant advances in tree-fruit production in British Columbia than any previous period in the history of the fruit industry. Several of the new procedures apply to pest control, and are developments original to this province. Some of them are briefly discussed herein. They were jointly introduced since 1940 by officers of the Fruit Insect Laboratory, Summerland, and the Horticultural Branch, British Columbia Department of Agriculture.

Spray Residue, Soil Poisoning, and the Dual Fruit-wiper

In the late 'thirties, excessive arsenical spray residue had cut off British Columbia apples from the valuable United States market. Unfortunately, heavy lead arsenate spraying was necessary to check the steadily increasing inroads of the codling moth, *Carpocapsa pomonella* (L.). Field experiments in 1939 and 1940 showed that better control of the codling moth could be attained by lessening the periods between the first brood spray applications in May and early June, and by substituting cryolite (sodium aluminium fluoride) or fixed nicotine-petroleum oil for lead arsenate in later treatments (Marshall, 1943). This procedure was recommended and the industry quickly adopted and profited from it. Within a year excessive arsenical spray residue was a thing of the past and the United States market had been regained for over a million boxes of apples a year.

Four years later, Okanagan Valley orchardists led the way in eliminating arsenicals from the spray schedule. In so doing, not only did they remove the possibility of arsenical contamination of fruit but, perhaps more important, they ended the danger of such serious soil poisoning as had occurred in thousands of acres of fine orchard land in the State of Washington.

A survey of packing-houses in 1939 had shown that much of the apple-wiping equipment in the tree-fruit area was inefficient and, doubtless, had been a factor in the loss of the United States market. Shortly before this survey, a new type of fruit and vegetable cleaner had been developed in the United States. It was fitted with revolving brushes and an exhaust fan in addition to the buffer cloths characteristic of the existing wipers. Although nothing was known of its capacity to clean apples, a dual wiper was imported and many chemical analyses were made at the Summerland laboratory to determine its efficiency. The new machine proved superior to the buffer wipers in three respects. It removed more spray residue; it produced a more attractive finish on the fruit; it removed poisonous dusts from the atmosphere. All new wiper installations were recommended to be of this type and packing houses have followed the recommendation with success.

High Viscosity Dormant Spray Oil

The use of dormant petroleum oil was becoming standard practice in western deciduous fruit orchards by 1930. It was generally accepted, and is still accepted in the western United States, that the best type of oil, phytotoxicity and insecticidal effectiveness considered, has a Saybolt viscosity of 100-110 seconds at 100°F. But many orchards in British Columbia suffered bud injury from that type of oil and, in districts heavily infested with the San Jose scale, *Aspidiotus perniciosus* Comst., it lacked effectiveness. Experiments were begun in 1939 to overcome these difficulties. Five years later a new type of dormant oil of 200-220 S.S.U. viscosity was introduced and it is now used throughout this province. There has been less bud injury since the industry abandoned the lighter oil and control of

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2 Senior Entomologist.

the San Jose scale and the European red mite, *Metatetranychus ulmi* (Koch), has been measurably improved (Marshall, 1948).

Dormant Oil-Lime-Sulphur

While the experiments on petroleum fractions were underway, field trials were proceeding with a number of ideas for improving control of the San Jose scale. From that work eventually came a dormant spray mixture that is still the most effective preparation available for killing crusted San Jose scale. It is a mixture of heavy dormant oil and lime-sulphur. In the days of conventional hand application of spray mixtures the oil concentration was two per cent. and the lime-sulphur four. Nowadays the mixture is applied by automatic concentrate applicators at six gallons of oil and twelve of lime-sulphur per acre. There are three advantages in the use of this mixture as compared with oil alone or lime-sulphur alone. First, the presence of the oil renders the lime-sulphur less irritating to the operator. Second, the quantity of oil being only half that required where oil alone is used, the danger of oil injury to buds and twigs is minimized. Third, although synergism has not been established, the mixture seems more toxic than would be expected from the individual effects of the two constituents.

"Low Sulphonation" Summer Spray Oil

Another innovation in orchard pest control in this province is the so-called low sulphonation petroleum oil of about 75 per cent. unsulphonated residue that is used for foliage application. Before the introduction of this oil, only summer oils of about 94 per cent. unsulphonated residue were employed in fruit production. The latter oils cost the growers about twice as much as the "low sulphonation" type but gave no better pest control. The suitability of the cheaper oils was demonstrated in a series of field experiments carried out from 1939 to 1944. No "high sulphonation" summer oil has been used in British Columbia for about five years although it is still the only type of summer oil used in the western United States (Marshall, 1948).

Perhaps one reason that the cheaper oil has been satisfactory in this province is that summer oil has not been used at greater than 0.5 per cent. concentration in hand machines or at more than two gallons per acre in cocentrate machines. At higher concentrations, such as used in many other fruit-growing areas, it is somewhat more prone to cause foliage injury than the expensive oil.

Trunk Spray for Codling Moth Control

For a time in the early 'forties it appeared that the codling moth would soon bankrupt the British Columbia apple grower. In spite of a continually heavier and more expensive spray program the attacks of the insect increased and cullage mounted. In those days DDT was unknown and codling moth control was dependent upon spray applications of lead arsenate, cryolite, and fixed nicotine directed against the first-instar larva, the egg, or both. To supplement this treatment experiments were undertaken to determine whether the codling moth is vulnerable to insecticides when it is a cocooned larva and, later, when it is adult.

Foliage spraying with a dilute solution of dinitro cresol proved moderately effective against the adults but it was not brought to the point of commercial application (Dennys, 1942). Tree-trunk spraying with an emulsion of a petroleum solution (38-40 S.S.U. Vis. 100°F.) of dinitro cresol was developed sufficiently for some growers to use it with fair success against the overwintered cocoons (Heriot, 1942). At that time, however, DDT was under trial and very shortly it proved so effective against the codling moth that supplementary control measures became unnecessary. There have been signs recently that the effectiveness of DDT against the codling moth may may not be quite so outstanding as it was when that remarkable insecticide

was introduced. If that should prove to be so, the day may not be far off when supplementary control measures will once more be necessary. The foliage and the trunk sprays will be available if required, and there is little doubt they can be made more effective.

Monoethanolamine Dinitrocyclohexylphenolate

With the general use of DDT in Okanagan Valley orchards came increased trouble from phytophagous mites (Marshall, 1946). Neither of the acaricides available at that time proved satisfactory for holding the mites in check. One of them, the dicyclohexylamine salt of dinitrocyclohexylphenol, gave erratic results, particularly in cool weather. The other, xanthone, caused alarming dermatitis to susceptible orchard workers.

At the Summerland laboratory work had been conducted for several years on dinitrophenol derivatives as acaricides, and, among other compounds, the monoethanolamine salt of dinitrocyclohexylphenol had been made and its acaricidal value studied. This material proved superior to those recommended at the time (Morgan and Marshall, 1944). Even today it has a particular advantage over several of the acaricides of more recent introduction: apart from being relatively harmless to humans, it appears to have selective action, *i.e.*, it is not harmful to insect predators. A shortcoming of mono DNP, to give it its popular name, is that it may cause foliage injury if used in concentrated form in hot weather. When concentrate sprayers became standard equipment in the British Columbia fruit industry, therefore, the use of mono DNP declined.

The Automatic Concentrate Sprayer

After World War II, labour costs increased rapidly and the fruit grower was faced with a new problem. The value of his product did not advance with his production costs, chief of which was labour. Consequently, labour overhead had to be reduced.

One of the orchard operations that required a great deal of labour was spraying. In 1946, officers of the Summerland laboratory, in co-operation with the Provincial Department of Agriculture and the Defence Research Experimental Station, Suffield, Alberta, undertook to mechanize spraying operations. By 1948 the three services had built and successfully demonstrated an experimental machine. The first commercial units, based on this experimental sprayer, were available in 1949 (Marshall and Miles, 1948, 1949; Marshall, 1949). By 1952, spraying operations had been approximately 90 per cent. mechanized, and British Columbia orchardists were possibly farther advanced in methods of applying chemical control than those of any other fruit-growing area. The automatic concentrate sprayer has saved upwards of 75 percent. of the cost of labour for orchard spraying operations, and perhaps 20 per cent. of the cost of spray chemicals. It has almost eliminated hand spraying, the unpleasantness of which can only be appreciated by those who have spent long hours operating a spray gun.

Introduction of a Parasite of the Apple Mealybug

Seventeen years ago, the fruit growers of the Kootenay Valley noticed an unusual insect in their plantings. It soon became a serious problem because its copious excretion covered the fruit and resulted in the growth of a sooty fungus that rendered the fruit unsaleable until washed. This insect was the apple mealybug, *Phenacoccus aceris* (Sign.), a pest then known to occur only in one other area in Canada, namely, western Nova Scotia. In that area the insect had never been epidemic as it was in the Kootenay Valley; investigation indicated effective control by the parasite *Allotropa utilis* Mues. Subsequently *A. utilis* was reared at the Dominion Parasite Laboratory, Belleville, Ontario, and shipments of it were sent from time to time to the Fruit Insect Laboratory at Vernon. Five years after the first

liberation the parasite was well established in the Kootenay West Arm district and today it gives effective control of the apple mealybug. This must be one of the outstanding exemples, in Canada, of biological control by an introduced parasite (Marshall, 1942, 1944).

Trends in Pest Control Research

Most orchardists in this province are well aware of the importance of biological control of fruit pests. But isolated and abandoned orchards and orchards that have been cultivated but not sprayed show, organic farming enthusiasts to the contrary, that Nature alone will not ensure sufficient marketable fruit for a profitable commercial operation. Consequently, the first line of defence against pests is chemical control—but chemical control applied as sparingly as possible and based on the knowledge that the preferred chemicals are those that have low toxicity to beneficial insects and mites and to birds. In 1948 the investigators in the joint operations of the Canada divisions of Entomology and Chemistry at Summerland were provided with an excellent laboratory and staffs were substantially increased. It then became possible to study insect behaviour in addition to the immediate but practical problems involved in helping to keep the fruit industry on a profitable basis. Biological studies were given welcome support when Biological Control Investigations of the Division of Entomology stationed an investigator at the Summerland laboratory to work directly with Fruit Insect and Insecticide Investigations on the biology of orchard mites. From now on there should be good balance at Summerland between fundamental, long-term biological studies and the entomological-chemical investigations that are a season-to-season necessity.

Summary

During the decade 1940-1950 advances in production methods of the British Columbia fruit industry were greater than in any previous period; some of the most significant were original developments in pest control. These included:

1. Introduction of the dual fruit wiper.
2. Elimination of arsenicals from the spray schedule prior to the introduction of DDT. (This removed the dangers of arsenical poisoning of the soil and arsenical residues on fruits.)
3. Introduction of heavy dormant petroleum oil (200-220 S.S.U. Vis.), which is now the only type of dormant oil used in the province.
4. Development of heavy dormant oil—lime—sulphur mixture as the standard dormant spray mixture for apples and pears.
5. Introduction and general use of summer petroleum spray oil of low unsulphonated residue (under 75%).
6. Development of the tree trunk spray for codling moth control.
7. Introduction of the monoethanolamine salt of dinitrocyclohexylphenol as a selective acaricide.
8. The successful introduction and dissemination of the parasite *Allotropa utilis* for control of the apple mealybug.
9. The designing and construction of the Okanagan experimental sprayer. This machine led to the mechanization of orchard spraying and the general use of spray concentrates in British Columbia.

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NOTES ON THE CABBAGE SEEDPOD WEEVIL, CEUTORHYNCHUS ASSIMILIS (PAYK.) (COLEOPTERA: CURCULIONIDAE), AND ITS PARASITES[1]

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The cabbage seedpod weevil, *Ceutorhynchus assimilis* (Payk.), is an indigenous pest of cruciferous seed crops in Europe. It was first reported in North America by the Division of Entomology (1935, p. 463) from a specimen taken at Vancouver, British Columbia, by Hugh B. Leech in May, 1931. The insect did not become economically important in British Columbia until the importation of turnip, cabbage, and cauliflower seed from Europe was prevented in 1940 by the naval blockade of western Europe. There was then an increase in the acreage planted to cruciferous seed crops on Vancouver Island and the lower mainland of British Columia, and the weevil became the most important insect pest of these crops. The use of parasites to reduce damage by this pest was undertaken in 1943 as a co-operative project between the Field Crop Insect Laboratory at Agassiz, B.C., and the Dominion Parasite Laboratory, Belleville, Ont.

The weevil became economically important in the western United States about the same time as in British Columbia. It was reported in 1935 in the northwestern part of Washington, where most of the cabbage seed produced in the United States is grown (Baker, 1936). From this area it spread southward through Oregon to California, where it was reported in 1946 (Hagen, 1946).

In Washington it became of increasing importance and a laboratory, now known as the Northwestern Washington Experiment Station, was established at Mount Vernon, to investigate the weevil and other pests of cruciferous seed crops. Its biology, distribution, food plants, and parasites were studied (Hanson *et al.*, 1948).

Mr. R. Glendenning, Officer-in-charge, Field Crop Insect Laboratory, Agassiz, studied the course of the infestation in British Columbia from 1939 to 1945. The infestation on the mainland was severe during the early years of his investigation, but gradually became less severe until 1945, when it had virtually disappeared. During this period the infestation on Vancouver Island remained at a high level.

In 1949 a survey was initiated at the Vancouver laboratory to obtain information concerning parasitism of the weevil in British Columbia with special reference to the value of introduced species. Further information concerning its distribution and the degree to which it infests cruciferous seed crops was necessary. The project was continued in 1950 and 1951 and collections of infested material were obtained from the important seed-growing areas from June to October.

The insect was obtained from seed fields of cabbage, cauliflower, Brussels sprouts, and swede turnip and also from wild turnip, *Brassica campestris* L.; garden radish, *Raphanus sativus* L., growing as an escape; and a wild

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2 Agricultural Research Officer.

mustard, *Brassica juncea* (L.) Coss. The wild host plants are more widely distributed and it is from weevils infesting these that the cultivated cruciferous seed crops become infested. These wild plants remain green and succulent much later in the season than do the cultivated species. The latter species ripen and become unsuitable for larval feeding during July, whereas the former remain green until October and provide food for its extended seasonal activity.

The percentage of cruciferous seedpods infested by the weevil varies considerably from year to year (Table I).

TABLE I

Infestation of the cabbage seedpod weevil, *Ceutorhynchus assimilis* (Payk.), in British Columbia, 1949, 1950, and 1951.

Area	Seedpods Examined		Per Cent. Infested
Vancouver Island			
Cabbage	1949	3,830	94.7
"	1950	731	75.6
"	1951	656	55.9
Fraser Valley			
Turnip	1949	1,688	30.7
"	1950	1,210	54.6
"	1951	600	62.3

The percentage of cabbage seed destroyed by the larvae increases disportionately with the percentage of the seedpods infested. For example, an infestation of 80 per cent reduced the seed yield by about 40 per cent, whereas an infestation of 30 per cent reduced the seed yield by about 10 per cent. The reason for the increased percentage loss of seed in heavily infested fields is the larger proportion of pods in which there are 2 or more larvae.

Eleven species of parasites have been reared from the weevil on the Pacific coast. Of these, 7 species have been found in British Columbia, 8 in Washington (Breakey, *et al.*, 1944, and Hanson *et al.*, 1948), and 5 in California (Carlson, *et al.*, 1951). The parasite species and the state or province from which they have been reported are shown in Table II.

Table II shows that *Trichomalus fasciatus* (Thoms.) is the only parasite species that has been reported from each of the 3 areas; 6 of the species found in British Columbia have been reported from Washington, and 2 species reported from Washington have also been reported from California.

TABLE II

Parasites reared from the cabbage seedpod weevil on the Pacific coast.

	British Columbia	Washington[1]	California[1]
Amblymerus sp.		x	
Amblymerus mayetiolae Gahan			x
Bracon sp.	x		
Eupelmella vesicularis (Retz.)	x	x	
Eurytoma sp.	x	x	
Habrocytus sp.	x	x	
Necremnus duplicatus Gahan	x	x	
Spilochalcis side (Walk.)			x
Trichomalus fasciatus (Thoms.)	x	x	x
Trimeromicrus maculatus Gahan			x
Xenocrepis pura Mayr		x	x
Zatropis sp.	x	x	

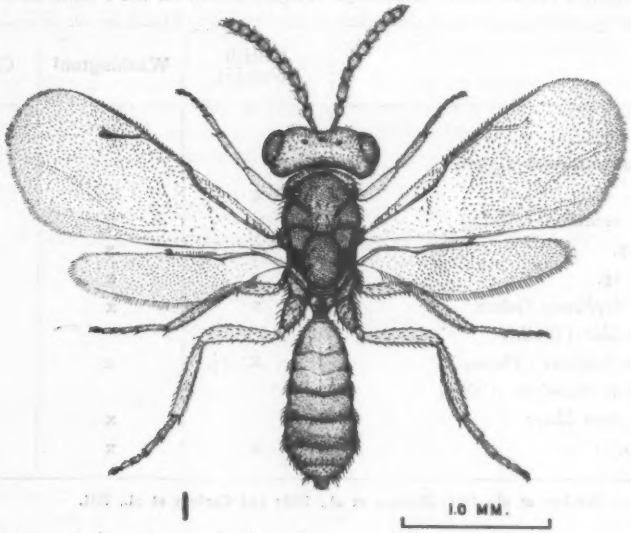
1 Records from Breakey et al., 1944; Hanson et al., 1948; and Carlson et al., 1951.

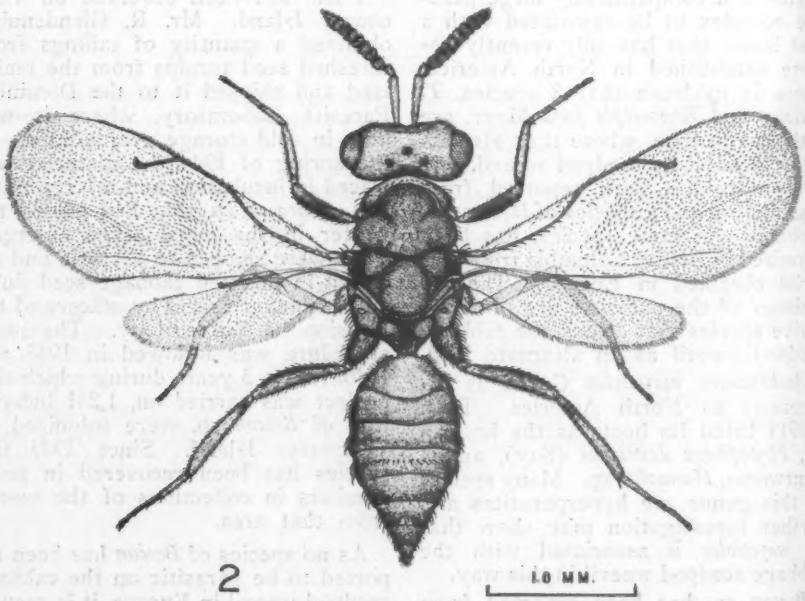
This is a comparatively large parasite complex to be associated with a host insect that has only recently become established in North America. There is evidence that 2 species, *T. fasciatus* and *Xenocrepis pura* Mayr, are native to Europe, where they also attack the cabbage seedpod weevil. *Habrocytus* sp. has been reported from Washington and a species of *Habrocytus*, probably the same species, has been colonized in British Columbia from material obtained in Europe. The remainder of the parasites are probably native species that attack the cabbage seedpod weevil as an alternate host.

Amblymerus mayetiolae Gahan is indigenous to North America. Peck (1951) listed its hosts as the hessian fly, *Phytophaga destructor* (Say), and a jointworm, *Harmolita* sp. Many species of this genus are hyperparasites and further investigation may show that *A. mayetiolae* is associated with the cabbage seedpod weevil in this way.

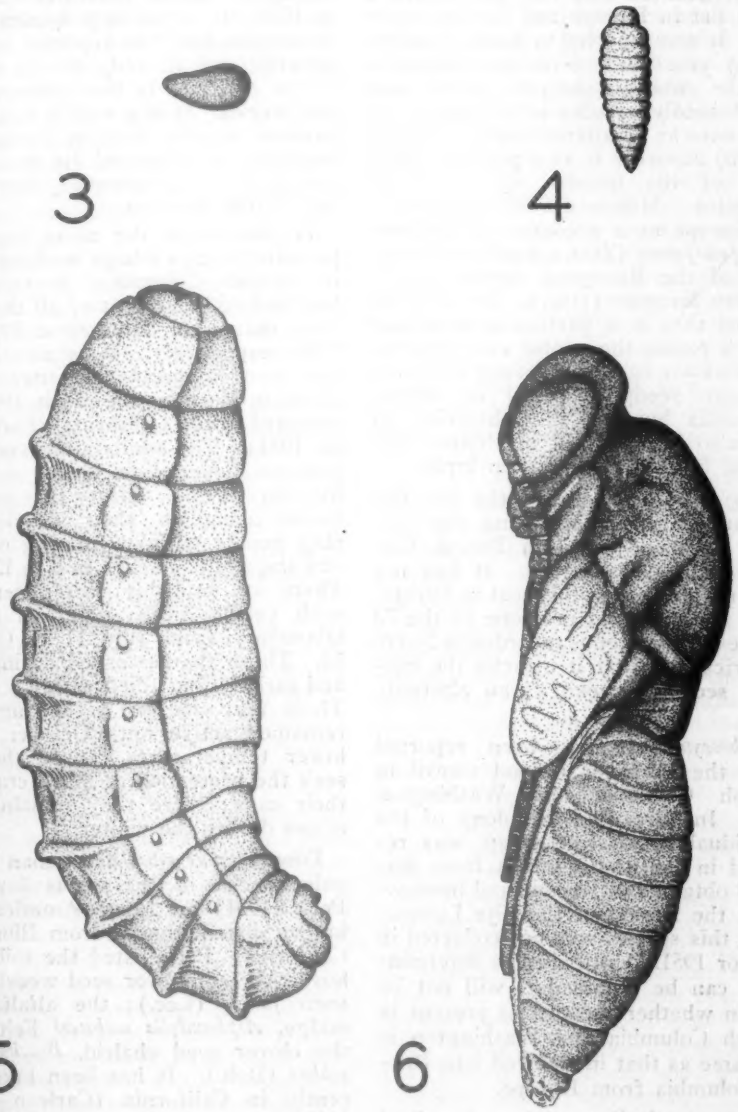
Bracon sp. has been reported from British Columbia only. In 1943 on Vancouver Island the cabbage seedpod weevil was more abundant and less heavily parasitized than on the mainland. At that time *Bracon* sp. was relatively abundant on the mainland but had not been observed on Vancouver Island. Mr. R. Glendenning obtained a quantity of tailings from threshed seed turnips from the mainland and shipped it to the Dominion Parasite Laboratory, where it was kept in cold storage over winter. In the spring of 1944 the material was placed in incubation and a large number of *Bracon* sp. that had passed the winter in the pupal stage emerged. They were shipped to Victoria and released in infested cabbage seed fields on Vancouver Island by officers of the Division of Entomology. The same procedure was followed in 1945 and 1946. In the 3 years during which this project was carried on, 1,241 individuals of *Bracon* sp. were colonized on Vancouver Island. Since 1949 this species has been recovered in small numbers in collections of the weevil from that area.

As no species of *Bracon* has been reported to be parasitic on the cabbage seedpod weevil in Europe, it is assumed that this species is a native of North America that attacks the cabbage seedpod weevil as an alternate host. Until the species is identified it will not be possible to determine whether it has any other hosts.





Figs. 1-2. *Trichomalus fasciatus* (Thoms.). 1, male. 2, female.



Figs. 3-6. *Trichomalus fasciatus* (Thoms.). 3, egg. 4, early larva. 5, late larva. 6, pupa.

Eupelmella vesicularis (Retz.) is widely distributed and has an extensive host list in Europe and North America. It was reported in North America many years before the establishment of the cabbage seedpod weevil, and undoubtedly attacks it or one of its parasites as an alternate host. Clausen (1940) reported it as a primary parasite of the hessian fly in North America. Morris (1938) reported it in Europe as a predator of *Dahlbominus fuscipennis* (Zett.), a primary parasite of the European spruce sawfly, *Diprion hercyniae* (Htg.). He also reported that it is parthenogenetic and that it passes the winter as a prepupa. *E. vesicularis* has been reared from the cabbage seedpod weevil in British Columbia but not in California. It has also been reared in British Columbia from *Hylemya* sp. on lupine.

Eurytoma sp. is one of the less important parasites attacking the cabbage seedpod weevil in British Columbia and Washington. It has not been reported from this host in Europe. It is assumed that it is one of the 73 species of that genus recorded in North America and that it attacks the cabbage seedpod weevil as an alternate host.

Habrocytus sp. has been reported from the cabbage seedpod weevil in British Columbia and Washington only. In July, 1949, a colony of 183 individuals of *Habrocytus* sp. was released in British Columbia from material obtained in Europe and incubated at the Dominion Parasite Laboratory; this species was not collected in 1950 or 1951. Until species determination can be obtained it will not be known whether the species present in British Columbia and Washington is the same as that introduced into British Columbia from Europe.

Necremnus duplicatus Gahan, described from specimens taken in Washington, is one of the most important parasites of the cabbage seedpod weevil in Washington and British Columbia. It is not known in Europe and no other host record is listed by Peck (1951) for North America.

Trichomalus fasciatus (Thoms.) is a European species that was described in 1878. It is the only species of the genus that has been reported in North America and its only known host in North America is the cabbage seedpod weevil. It is a widely distributed parasite of this host in Europe and probably accompanied its host when the latter was accidentally introduced into North America.

T. fasciatus is the most important parasite of the cabbage seedpod weevil in British Columbia: it comprised 94.1 and 85.9 per cent of all the parasites that were obtained in 1950 and 1951 respectively. It is also one of the most important parasites of the insect in Washington and in 1951 was reported from California (Carlson *et al.*, 1951). The adults sting and paralyse the host larvae before ovipositing on them. After the parasite larvae complete their development they pupate without forming cocoons and the adults emerge in 8 to 12 days. There are probably two generations each year. Adults emerged in the laboratory from July 11 to October 10. Those that emerged during July and early August died within 3 weeks. Those that emerged after August 15 remained active until October, when lower temperatures caused them to seek the protection of small cracks in their cage; there they remained inactive during the winter.

Trimeromicrus maculatus Gahan is the only species of the genus listed by Peck (1951) for North America. Its known distribution is from Illinois to California. Peck listed the following hosts: the sunflower seed weevil, *Dermoris fulvus* (Lec.); the alfalfa gall midge, *Asphondylia websteri* Felt; and the clover seed chalcid, *Bruchophagus gibbus* (Boh.). It has been taken recently in California (Carlson *et al.*, 1951) from the cabbage seedpod weevil, but it has not been reported in Washington or British Columbia. Whether it is a primary parasite or a hyperparasite is not known.

Xenocrepis pura Mayr has been reared from this host in California and Washington, but not in British Columbia.

Three colonies comprised of 1,269 individuals of this species were released in British Columbia in 1949 from material obtained in Europe and incubated at the Dominion Parasite Laboratory.

X. pura is reported to be the most important parasite of the cabbage seedpod weevil in California (Carlson *et al.*, 1951). It is less effective in Washington; and in British Columbia, the northern limit of the host insect's distribution, it has not yet been recovered even where colonized. The range of *X. pura* is the reverse of that of *T. fasciatus*: the latter is the most important parasite at the northern limit of its host's range.

Zatropis sp. is of minor importance in British Columbia and Washington and has not been reported from California. It is a North American species, but its other hosts are not known.

Although the present parasite complex does not prevent injury to cruciferous seed crops by the cabbage seedpod weevil, it reduces the amount of seed loss in two ways. The parasite adults sting and paralyse the host larvae; these larvae are often in the later instars before they are parasitized, but the feeding period of even the more mature larvae is shortened considerably. This reduces the number of seeds destroyed by each larva with the result that there is an immediate reduction in the amount of seed loss. There is a further reduction the following year caused by the reduction in weevil population due to the parasitism and resulting mortality of the weevil larvae.

Evidence of the effect of parasitism in reducing the number of seeds destroyed per larvae was obtained in 1950. A random collection of infested pods was taken from a swede turnip seed field in which the infestation was 39.7 per cent and the aggregate parasitism 79.8 per cent. There were 749 seedpods in the collection and 8,662 seeds, of which 872 were destroyed by larvae. The weevil larval population was 332. Therefore the number of seeds destroyed by each larva was 2.6. A random collection was taken from another field in which the infestation was 87.9 per cent and the aggregate parasitism 9.4 per cent. There was 348 seedpods in the collection and 4,389 seeds, of which 1,859 were destroyed by larvae. The weevil larval population was 394. Therefore the number of seeds destroyed per larva was 4.7. The difference in the numbers of seeds destroyed per weevil larva was highly significant. Insecticides had not been used on either of the plots from which the collections were taken.

Summary

The cabbage seedpod weevil is a European species that has become a major pest of cruciferous seed crops in western North America. Its spread has been facilitated by widely distributed wild host plants. The degree of infestation varies considerably from district to district and from year to year.

Eleven species of parasites are known to be associated with the cabbage seedpod weevil. The 2 most important species in North America, *Trichomalus fasciatus* and *Xenocrepis pura*, are of European origin. The remainder are probably native species that have accepted the cabbage seedpod weevil as an alternate host.

Parasitism of the cabbage seedpod weevil reduces the amount of seed loss in 2 ways:—

1. When the adult parasites sting and paralyse the weevil larvae, thus preventing further feeding, there is an immediate and significant reduction in the number of seeds destroyed by each cabbage seedpod weevil larva.

2. Parasitized larvae are killed, so that the infestation and seed loss the following year are reduced.

The adult male and female and the egg, early larva, late larva, and pupa are illustrated in Figs. 1-6. The original drawings were prepared by George Yamanaka, formerly of the Vancouver laboratory.

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NOTE ON THE OCCURRENCE OF RHAGOLETIS FAUSTA (O.S.) (DIPTERA: TRYPETIDAE) IN THE OKANAGAN VALLEY

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In the winter of 1950, a sample of frozen sour cherries infested with dipterous larvae was received from the Canada Experimental Station at Summerland. The larvae were partially decomposed when they reached the Fruit Insect Laboratory, Summerland, so that positive identification was impossible. However, it was believed that the larvae were of one of the cherry fruit flies common to many fruit-growing areas of North America.

Neither *Rhagoletis fausta* (O.S.) nor *R. cingulata* (Loew) has previously been recorded from the Okanagan Valley. In British Columbia *R. fausta* has been a pest in the Kootenay district for many years. It was also reported from the north shore of the Shuswap Lake, opposite Canoe, in 1936, and at Salmon Arm in 1937. *R. fausta* is the only species recorded from the Flathead Valley of Montana, whereas *R. cingulata* is the only species found in the lower mainland of British Columbia. Both *R. fausta* and *R. cingulata* are pests on Vancouver Island and as far north as Wenatchee in the State of Washington.

The source of the infested cherries was traced to an orchard in the Bear Creek district, about three miles from the Westbank ferry landing. In the spring of 1951, traps were set out in this orchard to determine what species of fruit fly was present. On May 31, soil sifted from under the sour-cherry trees yielded five puparia and two empty pupal cases. The latter were in good condition, suggesting that flies had recently emerged from them, although no adults were seen in the orchard at this time. Seven days later one fly was caught in a soil emergence cage and two on a sticky board. These flies were subsequently identified as of *Rhagoletis fausta* (O.S.) by Mr. J. F. McAlpine, Division of Entomology, Ottawa.

Fly emergence reached its peak in the third week of June. By the end of the month almost every sour cherry (largely Montmorency) contained one or more maggots, and an occasional sweet cherry (Bing and Lambert) was also infested. A few flies were still found alive on the sticky boards when trapping was discontinued on July 10.

Orchard and packing-house surveys conducted in the Westbank and Kelowna districts by officers of the Provincial government did not reveal any further orchards infested with the cherry fruit fly.

KEY TO PUPARIA OF THE DIPTEROUS PARASITES OF MALACOSOMA SPP., IN BRITISH COLUMBIA[1]

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Laboratory of Forest Biology, Vernon, B.C.

The following is an illustrated key to the purparia of dipterous parasites reared by the Forest Insect Survey at Vernon from *Malacosoma disstria* Hbn., *M. pluviale* (Dyar), and *M.* sp. nr. *pluviale* (Dyar), collected in British Columbia.

Grateful acknowledgment is given to J. H. McLeod of the Biological Control Unit, Division of Entomology, Vancouver, for the loan of puparia unrepresented or poorly represented in the Vernon reference collection, and to G. E. Shewell, Division of Entomology, Ottawa, for the identification of adults and criticism of the key.

The illustrations accompanying the key were drawn by B. A. Sugden.

Terminology in this and a published key (1952) is adapted from C. T. Greene's (1921) pioneering treatise on the puparia of North American Muscoids.

1. Posterior spiracles in a deep cavity, partially hidden from view.....2
— Posterior spiracles not in a cavity 4
2. Opening of cavity circular or oval; rim, relatively smooth with a few "warts", may be lightly sculptured 3
— Opening elliptical, the ellipse generally acute at both ends; rim strongly sculptured.....**(Fig. 1) Sarcophaga aldrichi** Park.
3. Rim about opening of cavity, rounded, the edge incurved; a few obscure "warts" on outer edge of rim **(Fig. 3) Pseudosarcophaga affinis** (Fall.)
— Rim somewhat flattened, edge not incurved, usually a portion extruded; "warts" on rim prominent **(Fig. 2) Sarcophaga houghi** Ald.
4. All stigmal slits strongly serpentine 5
— Stigmal slits straight or only slightly curved (usually some of stigmal slits somewhat serpentine in **Patelloa pachypyga)** 6
5. Stigmal plates strongly protruded; stigmal slits in three discrete groups; stigmal ridges broadly rounded; button shallow, may be obscure; no swelling ventrad to plates; pupal horns not extruded **(Fig. 4)**† **Carcelia malacosomae** Sell.
— Stigmal plates slightly raised; stigmal slits neither on ridges, nor in three discrete groups; button large, circular; small swelling ventrad to plates; pupal horns extruded ..... **(Fig. 5.) Achaetoneura frenchii** (Will.)*
6. A swelling (protuberance) ventrad to stigmal plates 7
— No swelling ventrad to plates.....10
7. Posterior end of puparium slightly depressed above horizontal axis; stigmal plates at acute angle to longtitudinal axis of puparium 8
— Posterior end of puparium not depressed above horizontal axis; stigmal plates at right angle to longtitudinal axis 9
8. Sides of puparium smooth, may be sparse transverse wrinkles; pattern of spinules readily discernable ..... **(Fig. 6) Exorista mella** (Wlk.)*
— Puparium rugose over whole surface; pattern of spinules somewhat obscured by rugosity—**(Fig. 7) Tachinomyia similis** (Will.)

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2 Agricultural Research Officer.

† Stigmal slits normally much more serpentine than in figure. (G. E. S.)

* Adults of species marked with an asterisk emerge during the summer; the remaining species overwinter as puparia and the adults emerge during the spring.

9. Protuberance small and shallow; plate fan-shaped, button at edge; ridges bearing stigmal slits almost straight; puparium smooth.....**(Fig. 8) Compsilura concinnata Mg.***
— Protuberance very prominent; plate circular, button not at edge; stigmal slits curved; puparium rugose **(Fig. 9) (Rileymyia americana** (B. & B.)
10. Centre of button above horizontal axis of stigmal plate; stigmal ridges, narrow. strongly raised, gradually curved downward toward ends; anal slit vertical; usually adult emerges from host pupa ..... **(Fig. 10) Nemochaeta lateralis** (Macq.)*
— Centre of button below horizontal axis of plate; stigmal ridges only slightly raised; anal slit horizontal 11
11. Stigmal slits, at most, only slightly curved; stigmal button well-defined, off centre of area enclosed by stigmal slits ..... **(Fig. 11) Euexorista futilis** (O.S.)*
— One or more stigmal slits usually with double curve, or a right-angled curve; button ill-defined, centrally located among stigmal slits ..... **(Fig. 12) Patelloa pachypyga** A. & W.

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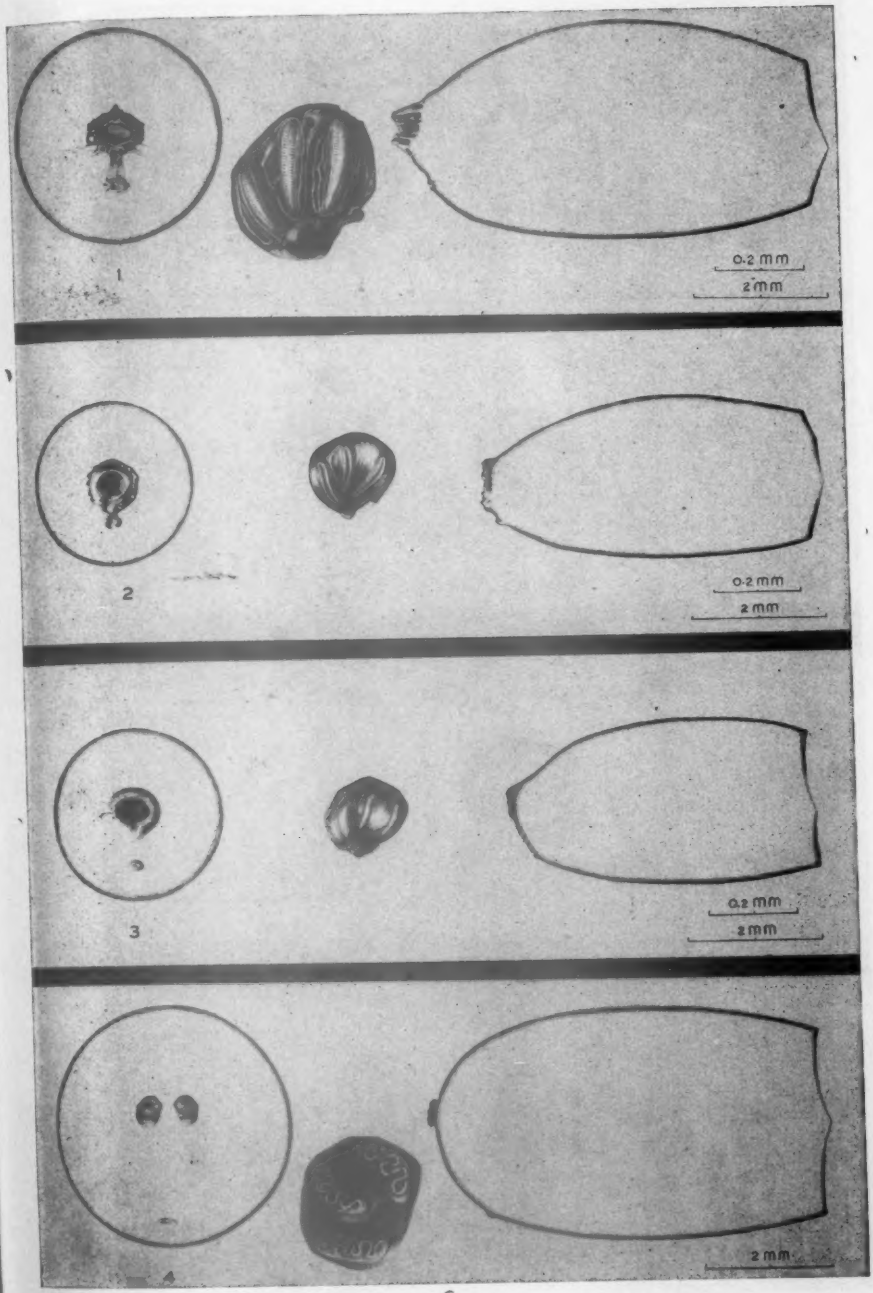
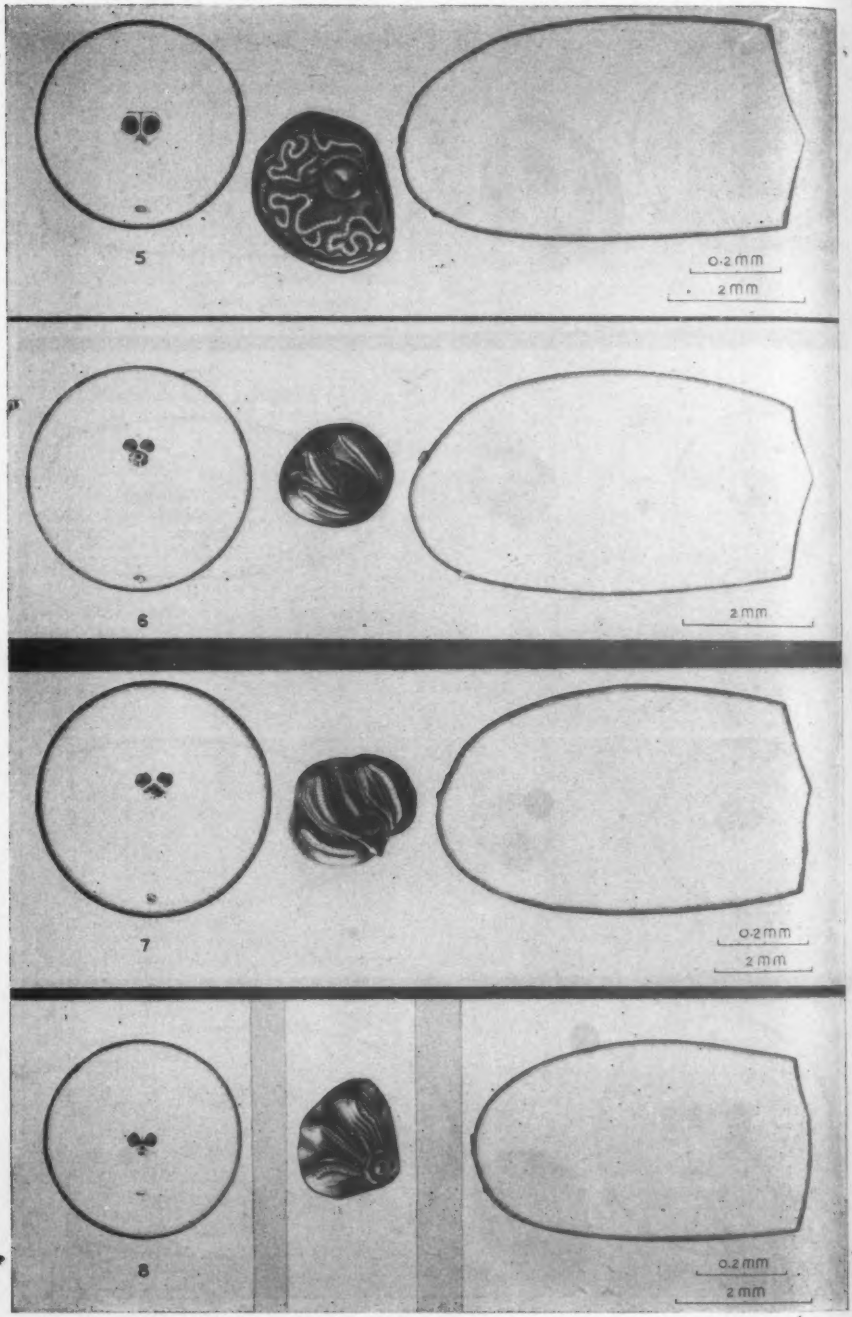


ROSS— DIPTEROUS PARASITES OF MALACOSOMA



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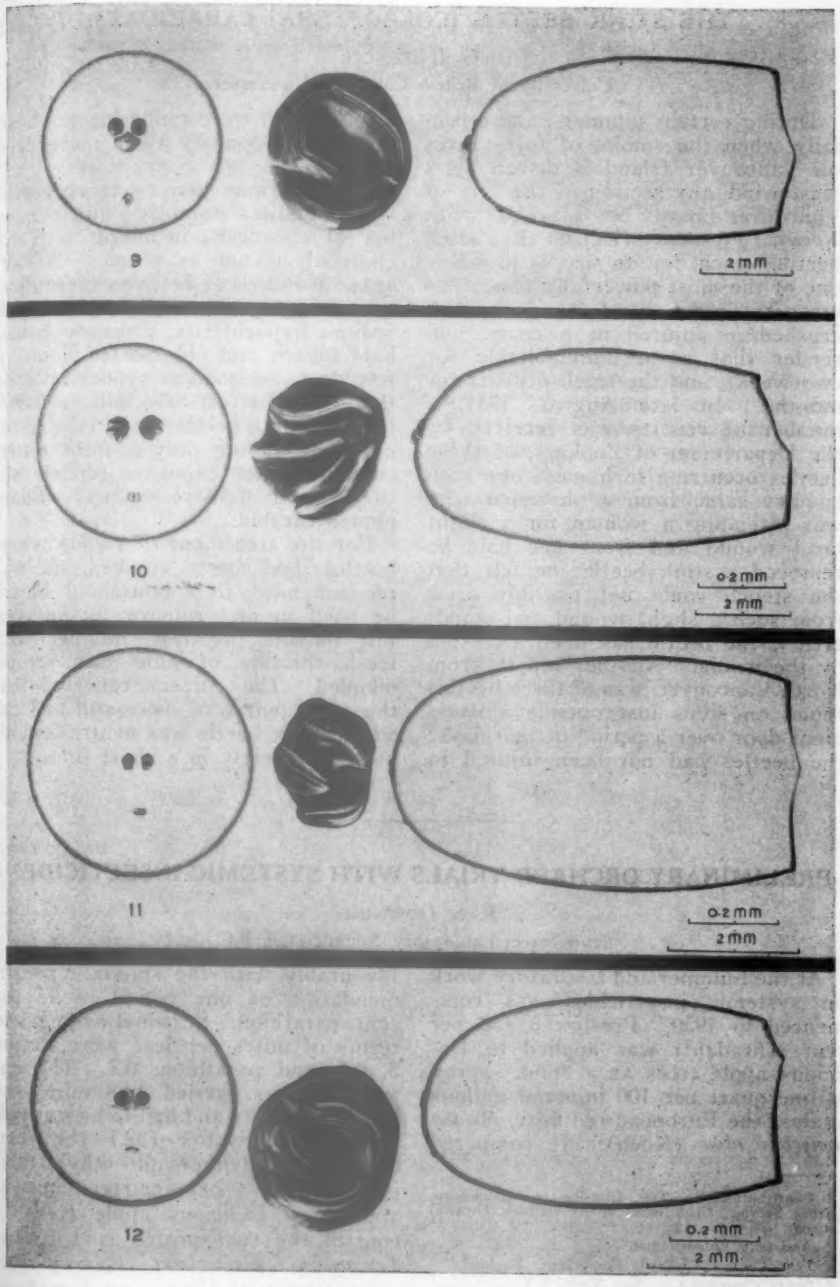

ROSS— DIPTEROUS PARASITES OF MALACOSOMA

UPON NEUTRALIZING THE ODOUR OF NOMIUS PYGMAEUS (DEJ.), THE STINK BEETLE (COLEOPTERA: CARABIDAE).

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During certain summers, and especially when the smoke of forest fires on Vancouver Island is driven by a west wind, any section of the City of Vancouver may be plagued with *Nomius pygmaeus* (Dej.), the stink beetle, which, for its size, is probably one of the most powerfully obnoxious creatures in the world. One individual, crushed or injured in a room, will render that room uninhabitable for two weeks, and the smell persists for months. In late August, 1951, a number of reports was received by the Department of Zoology, of these beetles occurring in homes; one such enquiry came from a physician who was attending a woman for a slight head wound and from her hair he removed a stink beetle; he felt that the stench could not possibly arise from such a slight wound and wondered if the beetle had been attracted by the wound. Another report, from North Vancouver, was of three beetles found on steps just outside a basement door over a period of two days; the beetles had not been injured in any way but were rendering the basement most foul by their mere presence.

From various sources, three beetles were obtained uninjured and a number of chemicals, including activated charcoal, tested as possible deodorants. None was effective except those containing active chlorine such as sodium hypochlorite, ordinary household bleach and chloride of lime. A few drops of sodium hypochlorite on the cork of a test-tube will deodorize the smell of a beetle in the tube in ten minutes, leaving only a faint musty odour: further exposure renders the beetle as inoffensive as any ordinary pinned carabid.

For the treatment of rooms where beetles had been crushed, it was recommended that household bleach be used in an ordinary fly sprayer. For outside premises, dusting with fresh chloride of lime was recommended. The citizens reported that the treatment was successful and the stink of the beetle was neutralized almost completely in a short time.

PRELIMINARY ORCHARD TRIALS WITH SYSTEMIC INSECTICIDES[1]

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Fruit Insect Laboratory, Summerland, B.C.

At the Summerland laboratory work on systemic insecticides was commenced in 1950. Prestox 3 (30 per cent schradan[3]) was applied to Delicious apple trees as a "pink" spray at one quart per 100 imperial gallons against the European red mite, *Metatetranychus ulmi* (Koch). It compared favourably with the standard recommendation of one pound of 15 per cent. parathion. Seasonal averages in terms of mites per leaf were Pestox 3, 0.6, and parathion, 0.2. The untreated trees carried 14.8 mites per leaf in late May and had to be sprayed. In August, Systox (32.1 per cent. diethyl S-ethylmercapto-ethyl thiophosphate)[4] at one quarter-pint was applied to Delicious apple trees to control the two-spotted spider mite, *Tetranychus bimaculatus* Harvey. A comparison with 15 per cent. parathion, one pound is given in Table I.

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2 Assistant Entomologist.

3 Pest Control Limited, Cambridge, England.

4 Geary Chemical Co., New York, N.Y.

5 C1014, Dow Chemical Co., Midland, Michigan.

6 Naugatuck Chemicals, Elmira, Ontario.

TABLE I

Effect of summer applications of acaricides against the two-spotted spider mite on apple; materials applied by a conventional hand-gun sprayer on August 27, 1950.

Acaricide	Amount per 100 gal.	Average number mites per leaf		
		Before spraying	After spraying	
		Aug. 27	Sept. 1	Sept. 9
Systox, 32.1%	0.25 pt.	24.3	0.3	0.9
parathion, 15%	1 lb.	23.6	0.2	0.9
check	no treatment	13.0	10.6	4.8

In 1951, formulations were changed; schradan and Systox were supplied as 45[5] and 50 per cent. liquid concentrates respectively. Both materials were applied as "pink" sprays to control the clover mite, *Bryobia praetiosa* Koch, on Newtown apple trees. Schradan, at one quart, caused slight marginal leaf injury, but Systox, at one-quarter pint, caused no sign of phytotoxicity. Results from two orchards are summarized in Table II.

TABLE II

Effects of "pink" application of acaricides against the clover mite on apple; materials applied by conventional hand-gun sprayer in May, 1951.

Orchard No. 1

Acaricide	Amount per 100 gal.	Average number mites per leaf				
		May 25	June 8	June 21	July 4	Aug. 9
Systox, 50%	0.25 pt.	0.0	0.0	0.0	0.0	0.6
schradan, 45%	1 qt.	0.0	0.0	0.0	0.1	0.6
parathion, 15%	1 lb.	0.0	0.0	0.1	0.4	12.8
check	no treatment	0.6	0.6	3.4	8.4	(sprayed July 4)

Orchard No. 2

		May 23	June 6	July 16	Aug. 7	
Systox, 50%	0.25 pt.	0.0	0.1	0.3	0.3	
parathion, 15%	1 lb.	0.0	0.1	0.5	4.0	
Aramite, 15%	2 lb.	0.1	0.1	3.6	19.1	

Another experiment was carried out to determine the effects of systemic insecticides applied as "pink" sprays against mites that overwinter as adult females. In the southern Okanagan in 1951, most of the mites had moved from their winter quarters and had started to deposit eggs by the time apple flower buds were in the pink or balloon stage. For most effective results at this period, an acaricide should have either a long residual

action against active stages or an ovicidal action and, in addition, a high initial toxicity to the adult mites. Systox appeared to have the necessary requirements because it has long residual action. It was applied as a pink spray to Delicious apple trees infested with the yellow mite, *Eotetranychus flavus* (Ewing) (formerly called the Willamette mite, *Tetranychus willamettei* McG.). Aramite (15 per cent. beta-chloroethyl-beta-(p-tertiary butylphenoxy)-alpha-methyl ethyl sulphite),[6] the acaricide that is presently being recommended for control of the yellow mite in British Columbia orchards, was used at two pounds as a comparative material. The numbers of mite-injured leaves, recorded early in September, are summarized in Table III.

TABLE III

Effects of "pink" application of acaricides against the yellow mite on apple; materials applied by a conventional hand-gun sprayer in May, 1950.

Acaricide	Amount per 100 gal.	Percentage leaves injured in Sept.
Systox, 50%	0.25 pt.	0
Aramite, 15%	2 lb.	14
check	no treatment	92

Although aphid colonies were not counted, there was an obvious difference in the numbers of colonies on the two plots. On August 1, all plots except the one sprayed with Systox were heavily infested with both the woolly apple aphid, *Eriosoma lanigerum* (Hausm.), and the green apple aphid, *Aphis pomi* Deg. On the Systox plot there were no woolly apple aphids and only a few green apple aphids.

Systox Residues

Systox was applied to McIntosh and Newtown apple trees as a "pink" spray by an automatic concentrate sprayer at one quart per acre. At harvest, samples from both varieties were sent to Geary Chemical Co., New York, for chemical analysis. The McIntosh apples contained 1.8 parts of pure Systox per million and the Newtown apples less than 0.2 parts per million.

Conclusions

1. A 30 per cent schradan emulsible concentrate applied at the pink stage of apple bud development, at one quart per 100 gallons, was approximately equal in effectiveness to one pound of 15 per cent. parathion wettable powder against the European red mite.

2. As a "pink" spray, 45 per cent. schradan at one quart was superior to one pound of 15 per cent. parathion against the clover mite, but caused slight marginal injury to Newtown apple foliage.

3. Against the two-spotted spider mite, Systox (32.1 per cent.) at 0.25 pints per 100 gallons was equal in effectiveness to 15 per cent. parathion at one pound.

4. As a "pink" spray, Systox (50 per cent.) at 0.25 pints was more effective against the clover mite than 15 per cent. parathion at one pound.

5. As a "pink" spray against the yellow mite, Systox (50 per cent.) at 0.25 pints gave excellent control throughout the season and, in addition, controlled the woolly apple aphid and the green apple aphid.

ANNOTATED LIST OF INSECTS AND MITES COLLECTED ON BRAMBLES IN THE LOWER FRASER VALLEY, BRITISH COLUMBIA, 1951[1]

N. V. TONKS[2]

Fruit Insect Section, Laboratory of Entomology, Victoria, B.C.

A survey of insect and mites on brambles was made in 1951 as part of a long-term study of bramble fruit insects in the lower Fraser Valley. Host plants included both wild and cultivated species of *Rubus*. The common wild bramble in this area is the thimbleberry, *R. parviflorus* Nutt.; cultivated forms are limited mainly to raspberry, loganberry, and blackberry. Collections were made throughout the growing season.

Determinations were made by officers of the Division of Entomology, Ottawa, as follows: Coleoptera, Messrs. W. J. Brown and R. de Ruette; Diptera, Mr. J. F. McAlpine; Hemiptera, Dr. B. P. Beirne and Mr. L. A. Kelton. Acarina were determined by Dr H. H. J. Nesbitt, Carleton College, Ottawa, and Thysanoptera by Miss Kellie O'Neill, Bureau of Entomology and Plant Quarantine, Washington, D.C.

COLEOPTERA

Byturidae

1. **Byturus bakeri** Barber, western raspberry fruitworm.
   Adults taken on raspberry, loganberry, and thimbleberry, Abbotsford, Hatzic, late April to end of June, 1950, 1951.
   This is one of the more serious pests of bramble fruits in the Fraser Valley. Adults emerge in late April. Egg laying apparently begins about the middle of May, at which time the adult population is at its peak. Larvae reach maturity and leave the fruit in July and early August.

Coccinellidae

2. **Coccinella trifasciata subversa** Lec.
   Adults taken on raspberry, Huntingdon, 1951.
3. **Psyllobora** sp.
   Adults collected from loganberry and thimbleberry, Abbotsford, 1950, 1951.
4. **Stethorus punctillum** Ws.
   Adults collected from raspberry leaves heavily infested with mites, Lulu Island, 1950. This species was first reported in America by Brown (1950), who recorded it from Massachusetts and Ontario.

Curculionidae

5. **Brachyrhinus ovatus** (L), strawberry root weevil.
   Adults were found on raspberry, Huntingdon and Hatzic, June to August, 1950, 1951. This species is a serious pest of strawberries in the lower Fraser Valley, but observations have shown no large populations on raspberry, and no damage to the latter has been apparent.
   swarmed extensively in April and May,
6. **Brachyrhinus sulcatus** (F), black vine weevil.
   Adults collected from brambles, Huntingdon and Hatzic, June to August, 1950, 1951. This root weevil is also a serious pest of strawberries, but specimens have not been numerous on brambles, and no economic damage has been observed in the lower Fraser Valley.
7. **Rhynchites bicolor** (F), rose curculio.
   Adults taken on thimbleberry, Abbotsford and Mission, May, June, 1951. Buds of thimbleberry frequently show considerable damage from the feeding of this weevil, but no damage has occurred in cultivated bramble plantings.
8. **Sciopithes obscurus** Horn.
   Adults present on raspberry, Huntingdon and Hatzic, April to September, 1950, 1951. Very few specimens were found, and damage was not apparent.

Elateridae

9. **Agriotes ferrugineipennis** (Lec.).
   Adults taken on raspberry, Huntingdon, May, 1951.
10. **Ctenicera lobata caricina** (Germ.).
    Adult found on raspberry, Huntingdon, May, 1951.
11. **Ctenicera suckleyi suckleyi** (Lec.)
    Adults taken on raspberry, Clearbrook and Huntingdon, May, 1950, 1951.
12. **Limonius discoideus** (Lec.)
    Adults collected from raspberry, Clearbrook, May, 1950. This species was reported by Essig (1926) to be injurious to the buds and blossoms of fruit trees; no damage has been observed on brambles. Wireworm adults were fairly common on bramble foliage during April and May, but were not found later in the season.

Lampyridae

13. **Lucidota californica** (Mots.)
    Adults collected in small numbers from raspberry and thimbleberry, Huntingdon and Hatzic, April to October, 1950, 1951.

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1 Contribution No. 3071, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

2 Technical Officer.

Lathridiidae

14. **Melanophthalma** sp.
Adults common on raspberry, boysenberry, and thimbleberry, Yarrow, April, May, June, 1951.

Scarabaeidae

15. **Hoplia** sp.
One specimen collected from raspberry, Yarrow, May, 1951.

DIPTERA

Agromyzidae

16. **Agromyza (Liriomyza)** sp. **(A. pusilla** Mg. complex)
One specimen collected from raspberry, Huntingdon, 1951.

Anthomyidae

17. **Pegomyia rubivora** (Coq.), raspberry cane maggot.
Larvae collected from blackberry, Huntingdon, June, 1950.
This species has caused only slight damage to commercial plantations in the lower Fraser Valley.

Bibionidae

18. **Bibio** sp., ? **nervosus** Loew
Adults collected from brambles throughout the lower Fraser Valley, April, May, 1950, 1951. These flies and were found resting on a wide range of plants.

Chloropidae

19. **Thaumatomyia glabra** (Meig.)
Adults common on raspberry, loganberry, and thimbleberry, Abbotsford and Mission, April to September, 1950, 1951.
The larva was reported by Smith *et al.* (1943) to be predacious on aphids, especially those feeding below ground.

20. **Thaumatomyia grata** (Loew)
One adult collected from raspberry, Huntingdon, August, 1951.

Lauxaniidae

21. **Minnettia lupulina** (Fab.)
Adults collected from raspberry and thimbleberry, Huntingdon, June to September, 1951.

Opomyzidae

22. **Opomyza combinata** L.
One adult found on raspberry, Abbotsford, September, 1950.

Trupaneidae

23. **Terellia florescentiae** (L.)
Adults collected from raspberry, Huntingdon, August, 1951. The larva of this fly lives in the heads of Canada thistle.

HEMIPTERA

Anthocoridae

24. **Orius insidiosus** (Say)
One specimen found on raspberry, Huntingdon, August, 1951.

25. **Orius minutus** (L.)
Adults collected from raspberry and loganberry, Lulu Island, Huntingdon, 1951. Both these species of **Orius** are predacious on mites, thrips, leafhoppers, and other small insects. Collections on brambles during 1951 showed **O. minutus** to be the more common species. Adults were present in small numbers throughout the growing season.

Miridae

26. **Campylomma verbasci** (Meyer)
One specimen collected from loganberry, Lulu Island, September, 1951.

27. **Lygus** sp., ? **shulli** Knight
Adults common on brambles, Abbotsford, Hatzic, Lulu Island, April to September, 1950, 1951.

28. **Plagiognathus chrysanthemi** (Wolff)
Adults collected from raspberry, Huntingdon, August, 1951.

Nabidae

29. **Nabis ferus** (L.)
Adults collected from raspberry, loganberry, and thimbleberry, Hatzic, Lulu Island, September and October, 1951. Populations of this predator were not large. Specimens were collected on hosts having a considerable population of leafhoppers.

Pentatomidae

30. **Cosmopepla bimaculata** (Thos.)
Adults collected from raspberry, loganberry, and thimbleberry, Abbotsford, Hatzic, 1951. Specimens were common from May to September. Nymphs were occasionally observed clustered on loganberries in July, apparently feeding on the developing fruit.

HOMOPTERA

Aphididae

31. **Amphorophora rubi** (Kltb.)
Specimens collected from raspberry, Burnaby, July, 1949. Populations of this aphid were low on brambles, and no damage was apparent.

CicadeHidae

32. **Colladonus montanus** (Van D.)
Adults collected from raspberry and loganberry, Lulu Island and Huntingdon, August, September, 1951. Specimens were not numerous, and were found mainly on the lower parts of the bushes and weeds in the row.

33. **Dikraneura absenta** DeL. & C.
Adults collected from loganberry, Abbotsford, September, 1950.

34. **Macrosteles fascifrons** (Stal) complex (**divisa** auctt.)
Adults collected from raspberry, Huntingdon, August, 1951.

Typhlocybidae

35. **Typhlocyba rosae** (L.) rose leafhopper.
Adults collected from raspberry, loganberry, and blackberry throughout the lower Fraser Valley, 1950, 1951. These were the most common leafhoppers on brambles. There are two generations a year; adults of the first generation mature in June, those of the second generation in August. Adults were collected as late as November on loganberries where the trailing canes and dense foliage provided shelter.

HYMENOPTERA

Tenthredinidae

36. **Monophadnoides geniculatus** (Htg.), raspberry sawfly.
Second-generation larvae collected from raspberry, loganberry, thimbleberry, September, October, 1951. Slight damage by this species occurred on brambles in the spring.

LEPIDOPTERA

Aegeriidae

37. **Bembecia marginata** (Harr.), raspberry root borer.
Eggs found on raspberry and thimbleberry, August, September, October, 1950, 1951. This species is one of the more injurious pests of brambles in the lower Fraser Valley. Egg hatching began in mid-September in 1951 and was about 50 per cent. complete by the end of the month, but in 1952 hatching did not begin till the end of September. Approximately 15 per cent. of the eggs were parasitized in 1952.

Tortricidae

38. **Archips rosaceana** (Harr.), oblique-banded leaf roller.
Larvae collected from raspberry, June 20, 1951, and reared to adults in insectary, July 3, 1951. Infestations of this leaf roller were common on raspberries during 1951.

THYSANOPTERA

Phlaeothripidae

39. **Haplothrips** sp., near **niger** (Osb.)
Specimens collected from blackberry and loganberry flowers, Huntingdon, June, 1951.

Thripidae

40. **Frankliniella** spp.,**occidentalis** complex
Specimens collected from blackberry and loganberry flowers, Huntingdon, June, 1951. Most of the specimens were **F. moultoni** Hood; a few were of **F. trehernei** Morg. Some of the heavily infested flowers showed dark discoloration around the bases of the stamens, but otherwise little injury was apparent on the blossoms. Occurrence of thrips on harvested fruit seemed to be the major economic problem with infestations on brambles.

41. **Taeniothrips atratus** (Hal.)
Three specimens obtained from blackberry and loganberry bloom, Huntingdon, June, 1951.

42. **Taeniothrips vulgatissimus** (Hal)
Adults common in flowers of blackberry and loganberry, Huntingdon, June, 1951.

43. **Thrips tabaci** Lind., onion thrips.
Five adults collected from blackberry and loganberry bloom, Huntingdon, June, 1951.

44. **Thrips madronii** Mlt.
Specimens collected from blackberry and loganberry flowers, Huntingdon, June, 1951.

45. **Thrips** sp., near **fuscipennis** Hal.
Adults collected from blackberry and loganberry blooms, Huntingdon, June, 1951. Miss Kellie O'Neill, in commenting on the identification of these specimens, stated that the only published record for **T. fuscipennis** in North America is Hood's (1927) record of it in New York.

ACARINA

Tetranychidae

46. **Tetranychus bimaculatus** Harvey, two-spotted spider mite.
Specimens collected from raspberry, Lulu Island, June, July, 1950. There has been no excessive build-up in mite populations on brambles in the lower Fraser Valley area despite the widespread use of DDT since 1948 for control of the raspberry fruitworm. Mite populations during 1951 on brambles were almost nil.

47. **Eotetranychus pacificus** (McG.), Pacific mite.
Specimens collected from raspberry, Lulu Island, July, 1949. One raspberry plantation on Lulu Island had a heavy infestation of **E. pacificus** in 1949, but there has been no further outbreak of it here.

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RECORDS OF THE TICK OTOBIUS MEGNINI (DUGES) FROM BRITISH COLUMBIA (ACARINA: ARGASIDAE)

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Otobius megnini (Dugès) is a common parasite of cattle in the southern United States, where it is known as the spinose ear tick. Farther north, it is less plentiful and Cooley and Kohls (1944) list only nine instances of its presence in Oregon, Washington, Idaho, and Montana. In these records its hosts were deer, mountain sheep, man, rabbit, cattle, and horses. This tick was first collected in Canada in 1941, when a nymph was taken from a cat at Ewings Landing on Okanagan Lake, British Columbia. This area lies below Terrace Mountain, upon which dwells a small band of mountain sheep. It is of interest that the late Allan Brooks, in a personal interview, spoke of having seen ticks in the ears of these animals about 50 years ago. Possibly these were of the above species.

In 1943, a number of the ticks were taken from a mountain goat at Bryant Creek, near Windermere, British Columbia, by Dr. Ian McTaggart Cowan Two more collections were made by Dr. Cowan in 1950 from mountain sheep and a mule deer at Vaseaux Lake and Barriere. Because of the last record, attention was paid to deer brought out by hunters from the North Thompson Valley in the fall of 1951. Of the 28 deer examined, 15 had infested ears. The heaviest concentration was 172 ticks on one animal. The average infestation was approximately 30 ticks per infested animal. Domestic sheep graze in the same locality, but so far, no infestations have been found on them, although the ears of 350 were examined carefully. Why this tick restricts itself to feral hosts in its northern range is not yet known.

During the above survey 12 deer carcasses from the Okanagan Valley were examined and ticks were found on three of them; however, none were found on 41 carcasses from the Cariboo District (Clinton to Quesnel).

Reference

Cooley, R. A., and G. M. Kohls. 1944. The Argasidae of North America, Central America, and Cuba. American Midland Nat. Monograph No. 1: 21-31.

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BOOK REVIEW

"Insect Physiology", by 15 authors, Kenneth D. Roeder (Edit.) pp. xiv + 1100; with 256 figures, 108 pp. of references. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Limited.

The objectives of this volume are best expressed in the preface by the editor: " . . . the book is a critical discussion rather than a complete review of insect physiology . . . " and: "It has not been our intention to present insect physiology as an insulated compartment of knowledge."

The literature on insect physiology is now so vast that a complete review within the space of a thousand pages is impossible. Accordingly, certain omissions are understandable, especially since some of the omitted material is already reviewed in other books on insect physiology. Instead, subjects not covered elsewhere take its place. Deficiencies pointed out in this review are therefore intended as statements of fact rather than as derogatory criticisms of the book as a whole.

Notable among the new items is the "inclusion of information on the mode of action of enzyme inhibitors, drugs, and other chemical agents." The biochemical aspects of insect physiology are well reviewed throughout the book. Various phenomena associated with nerve function are also well covered. On the contrary, the more fundamental aspects of the structure and biophysics of living protoplasm are not mentioned, despite the fact that the most significant feature which distinguishes a living cell from a dead one is the internal control which it maintains over its colloidal state. Without reference to this phenomenon, all toxicological findings beg the question, because many effects are reversible until physical degeneration has occurred.

Considering the dominating influence of temperature on insect growth, it is surprising that the authors evidently did not consider it necessary to include brief coverage of growth-temperature relationships. Their scant reference to "temperature characteristics" of Crozier gives no hint of the tenuous and empirical philosophy of its interpretation. Excellent coverage is given of the role of hormones and enzymes in diapause of certain post-embryonic stages, but consideration is not given to diapause in eggs and embryos, nor is mention made of the possible ultimate involvement of water-binding in the colloids. The question of bound water in insects is passed off lightly in the face of much evidence of colloidal physics.

"Insect Physiology" is well written and indexed, and is a welcome addition to the literature on insects, and indeed no entomological library can be complete without it. It does not, however, entirely take the place of other works on the subject.

—Kenneth Graham.

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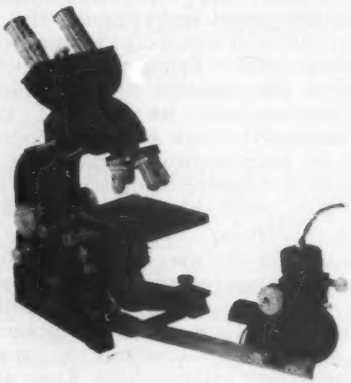

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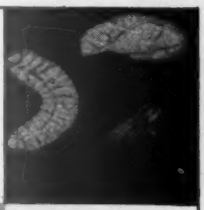

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cutworms
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spittlebugs
stink bugs
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strawberry leaf roller
strawberry weevil
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pod weevil
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salt-marsh caterpillar
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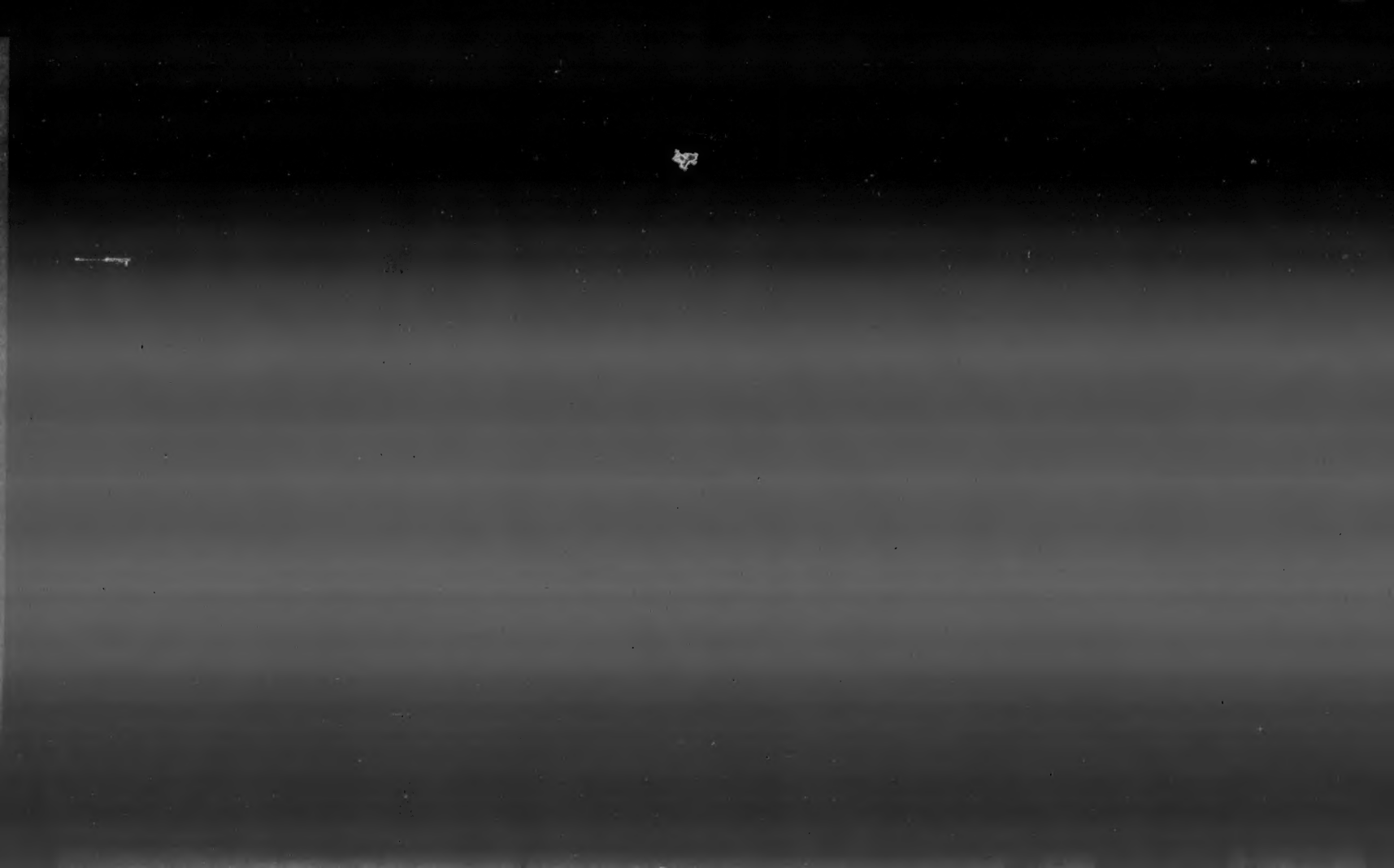
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